tyres! This also is distinctly wrong. Who in the year 1890 would use iron tyres on railway rolling stock, when Yorkshire iron costs £20 or more a ton, and when steel tyres can be obtained for a fraction of the cost, without even considering the extra mileage obtained from the steel tyres? Prof. Adams tells us in paragraph 65 of the important process of casehardening wrought iron by heating it in contact with prussiate of potash, &c. In the opinion of many, ordinary bones used in the same way give far better results; and another way of obtaining the same result is to use wood charcoal, soda ash and a little lime. These give excellent results and are generally in use by manufacturers of locomotives and the like. Casehardening in many cases may extend to a depth of $\frac{3}{32}$ inch in important details of valve motions; pins and less important parts may do with a casing of $\frac{1}{16}$ inch in depth.

Paragraph 187 deals with cleaning castings, and here the author would put manufacturers "up to wrinkles," which they certainly are not ignorant of! He speaks of "Holes (we presume he means blow holes) stopped with black putty, cement, or lead." This is all very well in its way, but a casting requiring such treatment should be broken up and sent to the scrap heap. In paragraph 358 the author recommends that safety valves for boilers should have flat faces to prevent sticking. This is not the view taken by locomotive engineers. The most satisfactory valve is one with a conical seat fitted with three or four wings to keep it in position. The actual bearing of the valve on its seat should be about $\frac{1}{16}$ inch wide, or difficulty will be experienced in keeping it tight. In paragraph 369 new boilers are said to be tested to twice their working pressure in the best practice. The author must mean with hydraulic pressure, although he does not say so. This is certainly not the case with new locomotive boilers, nor is it to be recommended on any considerations. The bursting pressure required for any particular boiler can be approximately calculated near enough for all practical purposes, and with a suitable factor of safety allowed there is no necessity for this high test pressure on a boiler. To put a test pressure on a boiler much above its working pressure is to subject it to undue and unnecessary strains, and serves no useful purpose. The usual hydraulic test for a new locomotive boiler does not exceed 50 or 60 lbs. per square inch—about the working steam pressure. This is quite sufficient for the detection of bad workmanship, which is mainly the object of the test. The only satisfactory way to test a boiler is to have it periodically thoroughly inspected by a competent man. The mere testing a boiler with hydraulic pressure is no guarantee that the boiler is fit for work.

Paragraph 398, on the tractive force of a locomotive, is interesting. The reader is told that "the mean effective pressure on the piston is commonly assumed to be 85 per cent. of the boiler pressure." This wholly depends on circumstances. The speed of the engine and the cut-off have everything to do with the mean effective pressure. A heavy 6-coupled goods engine may occasionally exert a tractive force corresponding to a mean effective pressure of 85 per cent. of the working pressure, when starting a heavy train; but, as the speed increases, the cut-off is regulated by the driver and becomes earlier. With a working pressure of 150 pounds, with such an engine, and a cut-off of 30 per cent., the mean effective pressure becomes about 69 pounds per square inch, or about 46 per cent. of the working pressure. A mean effective pressure of 85 per cent of the boiler pressure corresponds to a cut-off of approximately 70 per cent. of the stroke or, in other words, the engine is in full gear. It is necessary to assume the highest possible mean effective pressure when the necessary weight on the driving or coupled wheels is being determined for adhesion, since the adhesive weight is in a fixed proportion to the maximum tractive force exerted; but for the purpose of determining the tractive force of a locomotive under varying conditions of speed and cut-off, the mean effective pressure of the steam in the cylinders will be found to be a varying quantity, as may be seen by studying the excellent paper on locomotives, read by the late Mr. William Stroudley before the Institution of Civil Engineers.

It is not necessary to say anything further on these points. The volume contains a mine of information. The theoretical portion is not unduly burdened with complicated formulæ. Those used are simple, and easily used by those not well up in the higher mathematics. Mechanical engineers have to thank Prof. Adams for putting within their reach a most useful book, clearly and concisely written, nicely printed and well bound, and one that certainly ought to be much used by mechanical engineers and those of the allied professions.

N. J. L.

FOSSIL FLORA OF AUSTRALIA.

On the Coal and Plant-bearing Beds of Palæozoic and Mesozoic Age in Eastern Australia and Tasmania; with Special Reference to the Fossil Flora. By B. O. Feistmantel. Memoirs of the Geological Survey of New South Wales, 1890. (Sydney: Charles Potter, Government Printer.)

THIS work is a translation from the author's older work in the "Palæontographica," amended to 1887, edited by R. Etheridge, Jun., Government Palæontologist, and with notes by the Geological Surveyor-in-charge. The greatest development of the older beds occurs in New South Wales, where the coals, sandstones, and shales with plant impressions, are intercalated with porphyries to the thickness of 14,000 feet. Two remarkable facts give special interest to the beds: one is that under beds with Conularia, Spirifer, and Productus, believed to be Upper Carboniferous, certain plants of Mesozoic type appear; and the other, that just under these plant beds there are conglomerates regarded as having been deposited by the action of ice. The formations in New South Wales, Queensland, Victoria, and Tasmania, are described separately, but together they form a series; commencing with the Devonian Goonoo Goonoo, containing Lepidodendron; the Lower Carboniferous Lepidodendron beds; the Boulder beds, showing signs of glacial action, correlated with the similar Dwyka Conglomerate of Africa, and the Talchir Boulder bed of India; the lower marine beds of Upper Carboniferous age, followed by coal measures with Glossopteris, and an upper marine series; the Permian Newcastle beds with Glossopteris and heterocercal fish; the Hawkesbury Trias with

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Labyrinthodonts; and lastly some beds of Jurassic age. Until the base of the Upper Carboniferous is reached there is nothing abnormal, but at this point occur the remarkable intercalations of glaciated conglomerates, of which we have some slight indications in our English Permian, and which stretch both to India and Africa. This climatic change killed off the Lepidodendrons, and introduced a new flora containing the wide-spread Glossopteris and its ally Gangamopteris, and Nöggerathiopsis, types which would in Europe appear more at home in the Rhætic than in the Carboniferous, and which followed the changing climate as it spread to other continents. Meanwhile, the Carboniferous fauna of the seas is unaffected, and heterocercal fish accompany plants of quite Jurassic character in the Permian. This mingling of newer land floras with older marine faunas seems so universal in extra-European geology, particularly in America, that it appears as if during period after period the development of marine life was especially forced or quickened in the area which is now Europe, while terrestrial plant life was retarded, especially in England. The genera Glossopteris, Gangamopteris, and Nöggerathiopsis do not extend up beyond the Permian in Australia. In India Glossopteris is rare in the Jurassic, but its recorded extension into the Cretaceous of Russia must be questionable, while its supposed occurrence in the Tertiary of Novale is certainly due to its having been confused with the common Tertiary, and still existing, *Chrysodium aureum*, identical with it in venation but quite different in fruiting. In addition to these, the most noteworthy species are the beautiful adiantoid Rhacopteris of the Lower Carboniferous, to which several plates are devoted, and the Osmunda-like Thinnfeldia of the Mesozoic. The flora of the latter is only remarkable for its very European facies, and is said to include a Jurassic Sequoia, Cunninghamites, Baiera, Walchia, Taxites, and several Cycadeaceæ; it also shares with the Permian the fine *Brachyphyllum australe*, Feistm. There are altogether about 129 species or varieties described, of which about 50 are illustrated, and the volume is certainly a valuable contribution to the history of plant distribution.

J. S. Gardner.

OUR BOOK SHELF.

The Development of Africa. By Arthur Silva White. (London: George Philip and Son, 1890.)

There can be no doubt that Africa is destined to occupy a much more prominent place in the thoughts of Europeans than it has occupied hitherto. The recent marking-off of vast "spheres of influence" may not have very important immediate results, but sooner or later attempts will certainly be made on a great scale to find out in these regions new channels for industry and commerce. It is evident, therefore, that the conditions of the development of Africa ought to be carefully studied; and in the present work, Mr. White supplies all the materials, so far as they are now known, for an adequate comprehension of the subject. He begins with a bird's-eye view of the continent, showing its geological and physical structure, its oceanic and inland drainage-basins, and the coincidence of political settlement with oceanic drainage-areas. Next he deals with the geographical distribution of the chief mountain-systems, and the consequent development of the great river-systems, in relation to accessibility from the sea and internal communications. Under the heading of "climate and cognate phenomena" he treats of the distribution of temperature; actual temperatures; the distribution of atmospheric pressure, and prevailing winds; annual rainfall; distribution of soils; zones of vegetation; distribution of animals; classification of climates; and acclimatization. Then come chapters on the indigenous populations, Islam and Christianity, the traffic in slaves, the progress of exploration, commercial resources, the European domination, and political partition. In the concluding chapter the author presents the general principles underlying the development of Africa along natural lines, derived from an examination of the various aspects under which the continent is known to Europe at the present day. He displays a thorough mastery of the facts relating to the various questions he discusses, and his work will be of genuine service to all who may be for any reason, whether theoretical or practical, interested in the utilization of Africa's material resources. The volume is accompanied by a most valuable series of maps, specially designed by Mr. Ravenstein.

The Pinks of Central Europe. By F. N. Williams, F.L.S. 66 pages, with 2 plates. (London: West, Newman, and Co., 1890.)

This forms a third instalment of Mr. Williams's studies of the genus Dianthus. His first paper was devoted to an enumeration and classification of all the known species. In his second he described the pinks of Western Europe, and traced out in detail their synonymy and geographical distribution. In the present paper he deals in a similar manner with the species that inhabit Central Europe. For Central Europe as a whole he claims 76 species out of a total of 230, which are disposed through the different countries as follows: viz. Austria, 59; Roumania, 24; Servia, 22; North Italy, 17; Switzerland, 15; Germany, 11; Poland, 7; Denmark, 5; and South Sweden, 4. His descriptions are clear and concise, but he has followed the Continental authors in classing as species many types which most English writers would place as varieties. None of the species are new, but it is a great convenience to have them all brought together, and treated on a uniform plan. The book is dedicated to Cardinal Haynald.

Materials for a Flora of the Malayan Peninsula. By Dr. G. King, F.R.S. No. 2. 93 pages. (Calcutta, 1890.)

This is a second part of Dr. King's Flora of the Malay peninsula, reprinted from the Journal of the Asiatic Society of Bengal. It covers the orders Bixineæ, Pittosporeæ, Polygaleæ, Portulaceæ, Hypericineæ, Guttiferæ, and Ternströmiaceæ. These were dealt with in Hooker's "Flora of British India" in 1872–74. Since that time a large amount of new material has been accumulated, principally by Kunstler, Scortechini, and other collectors whom Dr. King has sent out. Out of the orders just enumerated the first and two last are well represented in the Malay peninsula. In Bixineæ, Erythrospermum, known before only in Mauritius and Ceylon, is now recorded from Perak, an endemic species. In the same order the two curious Malayan genera, Teraktogenes, of Hasskarl, and Ryparosa of Blume, are added to the Indian flora, and four species of the former, and six of the latter, all endemic, are here for the first time described. In Polygaleæ there are ten new species of Xanthophyllum. In Garcinia, which has lately been fully dealt with in Pierre's "Forest Flora of Cochin China," fifteen new species are described out of a total of thirty-six now known in the Malay peninsula. In Calophyllum there are six new species, in Kayea four, and in Ternströmiaceæ two new species of Adinandra, one of Ternströmia, one Eurya, one Actinidia, two of Pyrenaria, and three of Gordonia. The publication of Hooker's "Flora Indica" has given

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